PROJECT 2: FRAME ANALYSIS

Concepts

Finite element analysis; frame structures; meshing; beam sections. Post processing.

Problem Statement

A three dimensional frame analysis is performed. Post processing results relevant to frame analysis are generated.

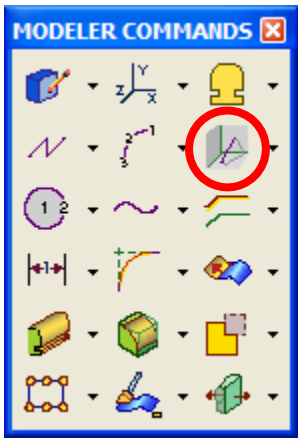
Steps in a Finite Element Analysis

1. Build model: Solid, shell, plate or wireframe
2. Apply boundary conditions
3. Mesh model: Create elements and nodes, assign material and structural properties
4. Solve model
5. View and post process results

Task

1. Build a wireframe model of the structure shown below
   a) A(0,0,3)[m]; B(5,0,6)[m]; C(5,0,0)[m]; D(0,2,3)[m]; E(4,5,3)[m].
   b) Generate the lines of the wireframe using the *3D Lines* command. Select *Single Line* and use RMB *Key In* for convenience.

   c) Multiple end points exist for the lines(I-DEAS quirk). Merge these using the *Surface Clean Up…* command and then *Clean Coincident Points* on the resulting icon panel



   a
2. Apply the boundary conditions by Clamping (*Clamp*) the points on the XZ-plane. At point E apply 5-kN force in the x-direction and a 4-kN force in the negative y-direction and a 3-kN force in the z-direction. You must use RMB *Location on Wireframe* to accomplish this step.
3. Save the model file.
4. Capture an isometric image of the wireframe using the *Print Screen* function. Paste this image into a Word file.

5. The frame is constructed from round bars with an outer and inner diameter of 0.015-m and 0.010-m respectively. Build the beam section for the frame.
6. Mesh the frame using GENERIC_ISOTROPIC_STEEL as the material and with an *element length* of 0.2-m.
7. Solve the model.
8. Capture separate images of the *Magnitude* of the model's *Deformation*, the *Amplitude* of its *von Mises* stresses and the structure's *Reaction Forces*. Record the maximum and minimum of the deformation and stress and the reactions at each of the structure's clamped joints.
9. Determine the x-, y- and z- components of deformation at the peak of the frame using *Probe* (and Zoom).

Report Requirements

1. Use the Mechanical Engineering memorandum format (list results in the body).
2. Is the magnitude of the deformation at the peak of the frame physically reasonable in comparison to the size of the structure? Why or why not?
3. Are the x-, y- and z- components of deformation at the peak of the frame physically reasonable? Why or why not?
4. Can you check the results using statics? Why or why not?
5. Other than the stresses calculated are their other ways in which the structure might reasonably fail?